OSTRACODA FROM A PLEISTOCENE LAKE DEPOSIT AT KOURARAU, WAIRARAPA

STEPHEN H. EAGAR

Department of Geology, Victoria University of Wellington, P.O.Box 600, Wellington, New Zealand

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ABSTRACT

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Four species of freshwater ostracods were found in a series of alternating calcareous and carbonaceous beds in a road cutting at Kourarau on the Gladstone-East Coast Road, Wairarapa. The Hinewaka Formation is formally described for the deposit and is considered to be Pleistocene in age. A nearby hydro dam is considered to be a present day analogy for the fossil lake.

KEYWORDS: Freshwater - lake-ostracods - Pleistocene - Wairarapa - Hinewaka Formation.

INTRODUCTION

Pleistocene lake deposits at Kourarau are found in a road cutting made in 1957 towards the summit of the Gladstone - East Coast Road (Grid reference T27 375 094) where a series of alternating calcareous and carbonaceous beds containing freshwater biota are exposed. The region was mapped previously by McGill (1956) who failed to record the deposit; Haskell (1962) studied the deposit and recorded the flora and fauna; Bunopas (1965) recorded the deposit but without further study. Vincent (1978) re-examined the cutting, by then largely overgrown and slumped, but not destroyed, recording the macro and micro biota and measuring the paleomagnetism. The author first examined the cutting in 1968 and collected a series of samples. He subsequently made several further visits. Today, the road cutting is overgrown and the faces are weathered. This has accentuated the horizons containing oncoliths, but has destroyed many of the microfossils. Further excavation would be required to collect more ostracods.

These lacustrine deposits described as the Hinewaka Formation (informal name) by Haskell (1962), overlie a conglomerate which in turn overlies the Pukenui Limestone. This lake deposit sits in a depression formed by a minor syncline. Most of the deposit appears to be preserved with the exception of the northern part which may have been removed when the large gully was eroded. The figured specimens are lodged in the collections of the Institute of Geological and Nuclear Sciences at Lower Hutt.

RESULTS

STRATIGRAPHY

The road cutting exposes a series of alternating peat and cream-coloured sediments. The latter sediments grade up with an increasing organic content sometimes into a horizon of peat. This is followed by an abrupt change from the peat into the cream sediments. The peats tend to thin to the west end of the road cutting.

The name Hinewaka Formation was used without definition by Haskell (1962). The type locality is the road cutting 4.5 kilometres from Gladstone on the East Coast Road at Grid reference T27 375 094 (Fig. 1). As now described, the Hinewaka Formation has three members:

1) Lowest (bottom) member of 7.8m of pebbly sands in 3 beds

A) 2.4 - 3.6m consisting of locally derived shell fragments and has well-rounded, scattered greywacke and jasper pebbles. Plant material occurs rarely. It is rusty-cream in colour, fragments of *Hyridella.* Thick (up to 1m) beds of oncoliths near the base overly a

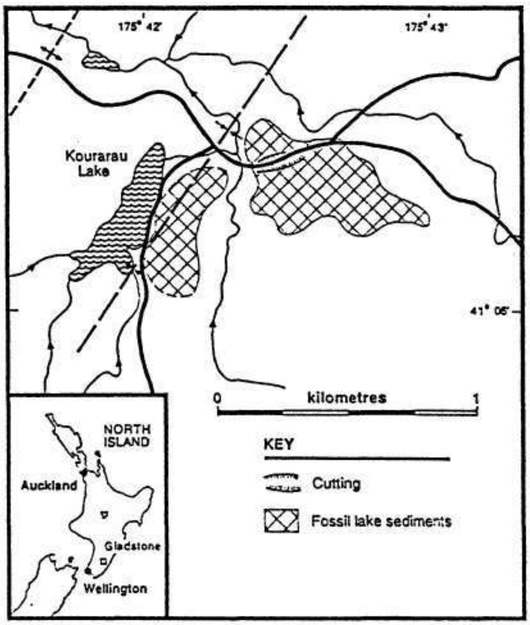

Figure 1. Locality map showing the position of the road cutting exposing the lake sediments and Kourarau Lake.

calcite-cemented conglomerate of the beds below.

B) Similar to the above but has a finer grain size grading up to clay at top.

C) The topmost bed is 0.75m thick. It is composed of a sandy silt, containing 20% plant remains. Between each bed (A, B, & C) is a band of peat from 50mm to 450mm in thickness.

Graded contact

2) Second member: four beds of alternating peat and calcareous marls, beds are deformed, but each bed maintains a constant thickness of about 1.8m thick.

Sharp contact

3) Third (top) member is similar to those below but has an irregular arrangement of the beds with peat thickness varying laterally within calcareous sediments. Abundant fossils occur in this member. Minimum thickness is 16m. This is the top of the outcrop.

The sediments comprising the lake deposit were formed by erosion of the surrounding hills which were, as now, formed of Pukenui Limestone. Evidence is given by the occurence of worn specimens of the marine fossil foraminifera *Uvigeria rodleyi* and *Notorotalia finlayi* within the freshwater lake sediments.

The lateral equivalent to the Hinewaka Formation may be the Ahiaruhe Formation (Collen & Vella 1984) which outcrops 25 kilometres to the southeast, where it also overlies the Pukenui Limestone.

Kennett (1964) described a section on the east bank of the Ruamahunga River. This is only a few kilometres south east of the lake deposit. The upper part of Kennett's sequence has conglomerates in the Ruamahunga Formation which may correlate with those at the base of the Kourarau lake deposit. The stratigraphy of the Hinewaka formation is shown in Figure 2.

PALEONTOLOGY

The following is a faunal and floral list compiled from the reports of Haskell (1962) and Vincent (1978):

Fauna

Vertebrata:

Large cross-sectioned bird bone possibly *Dinornis* or *Pachyornis*

Insecta:

Insect remains were frequently encountered.

Gastropoda:

Potamopyrgus antipodarum (Gray 1843)
Lymnaea tomentosa tomentosa (Gray 1850)
Gyraulus corinna (Gray 1850)
Physastra variabilis (Gray 1843)
Laoma caputspinulae (Reeves 1852)
Paraphanta juv.

Bivalvia:

Hyridella (Echyridella) menziesi (Gray 1843)
Sphaerium (Sphaerinova) novaezelandiae (Deshayes 1854)
Allodiscus c/f mossi (Murdock 1897) base broken

Ostracoda (Haskell 1962):

Loxocythere kingi Hornibrook, 1952 - incorrect identification as this is a marine species. It is probably a *Gomphocythere.*

Ostracoda (Vincent 1978):

One species of freshwater ostracod was retrieved from one horizon.

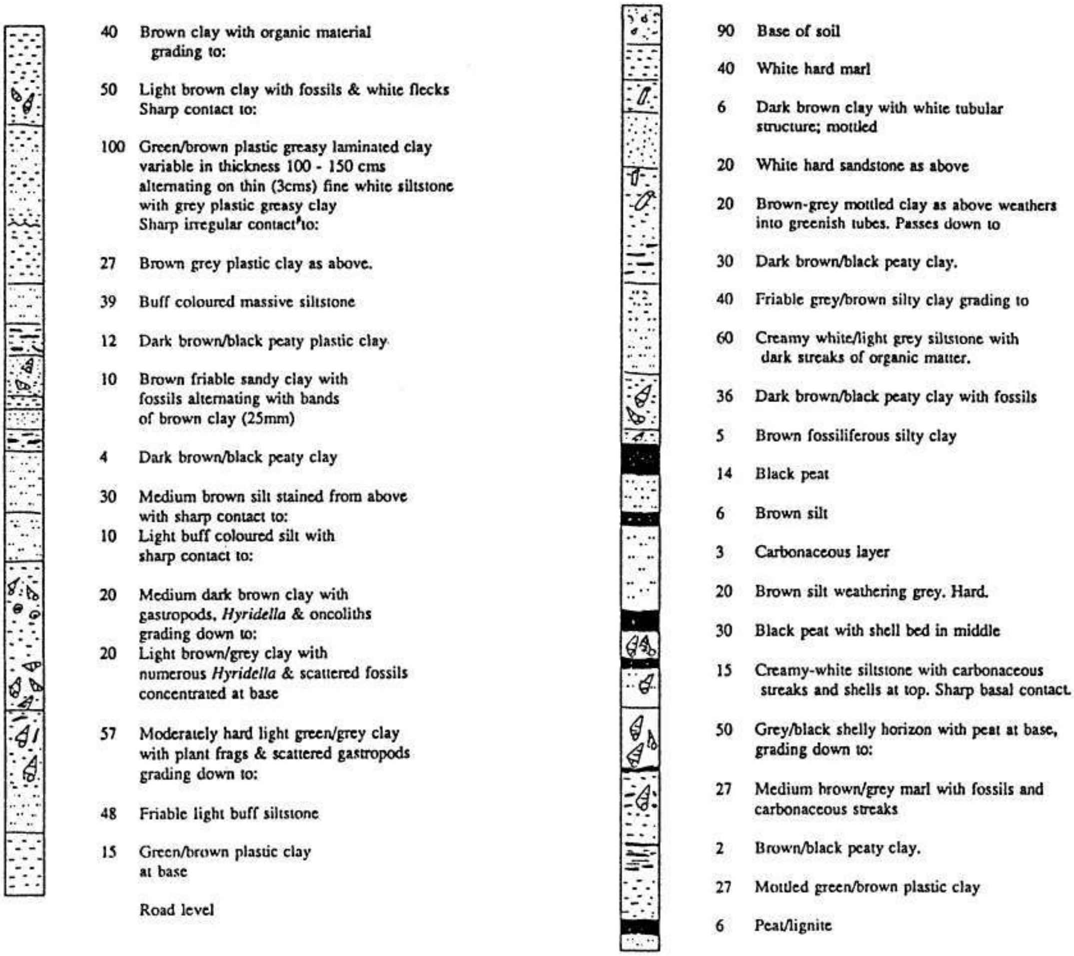

FIGURE 2. Stratigraphic column for the eastern end of the road cutting. Left section on north side of road; right hand section is on south side. Thicknesses shown in centimetres.

Flora

Wood:

Leptospermum sp.

Pollen:

Lycopodum cf varium
Gleichenia dicarpa
Dicksonia sp.
Cyathea sp.
Phymatosorus diversifolius
Monolete fern spores
Podocarpus totara type
Podocarpus sp.
Dacrycarpus dacrydioides
Dacrydium cupressum
Halocarpus bidwilli biforme type
Lagarostrobus colensoi type
Gonocarpus sp.
Myriophyllum sp.
Metrosideros sp.
Nothofagus fusca type
? *N menziesii*
? *Araliaceae*
Coprosma sp.
Asteraceae
? *Hebe sp.*
cf *Potamogeton*
Cyperaceae

Poaceae

Contaminants:
Cyathea dealbata
Myriophyllum sp.
Juglandaceae
Casurina sp.
Asteraceae

The author found one other species, not previously recorded by the above authors. This was *Chara braunii* Gmelin.

OSTRACODA

The author found ostracods in several horizons, but more frequently in the horizons containing some organic matter where they occur in large numbers. Due to the fragile nature of these freshwater species it is uncommon to find complete valves and carapaces are unknown at this locality. Furthermore, because some species and juvenile moults are more easily destroyed or dissolved, the ratio of the components of the original fauna is not preserved. The marl layers have fewer ostracods and the peat layers are devoid of them.

The preserved fauna is dominated by the relatively robust *Gomphocythere. Darwinula* is common, but the numbers are an order of magnitude smaller. Other species present are *Limnocythere* and *Canodonocypris*. Both are delicate species, the latter less so, but because of its size and limited calcification, it is relatively fragile.

Subclass: Ostracoda Latreille 1806
Order: Podocopida Müller 1894
Superfamily: Darwinulacea Brady and Norman 1889
Family: Darwinulidae: Brady and Norman 1889
Genus: Darwinula Brady and Robertson 1885
Darwinula sp

Remarks: This species occurs throughout the section where ostracods are found. Unlike the other species, it is found in the cream-coloured marls by itself. This represents an environment where the water flowed slowly. The author has collected this species live from similar conditions at Makara, near Wellington (Grid reference: R27 522 884)

These specimens are conspecific with the *Darwinula* found at Pyramid Valley but are not quite as inflated as the specimen illustrated by Hornibrook (1955). Deevey (1955) also recorded increasing numbers of *Darwinula* as *Gomphocythere* decreased, indicating a change in the environment. The same phenomenon occurs at Kourarau. It has not been possible to determine if the *Darwinula* found in the hydro lake are the same as the fossil ones since the fossil muscle scars were unable to be seen due to the nature of the preservation.

Superfamily Cytheracea Baird 1850
Family: Limnocytheridae Sars 1925
Subfamily: Limnocytherinae Sars 1925
Genus *Limnocythere* Brady 1868
Limnocythere mowbrayensis Chapman 1914

Remarks: This is a very fragile species that occurs in the organic-rich layers in small numbers. Deevey (1955) considered that this species was in competition with *Gomphocythere.* Many specimens would have been lost with the ground water and during the preparation process.

This species was originally described from Australia (Tasmania) and, although it has been recorded as a fossil from Pyramid Valley, no living specimens of this species have been found in New Zealand.

Genus: *Gomphocythere* Sars 1924
Gomphocythere duffi (Hornibrook) 1955

Remarks: This is the most common species in those horizons which contain some carbonaceous material. The more mature juvenile valves are preserved. Today it lives in weedy conditions where there is little water movement. Some female specimens (about 1% of the population) have a node in the posterodorsal region (Fig. 3,10). It is the same species that is found in Pyramid Valley and Hornibrook (1955) illustrated a similar specimen with a node.

Superfamily: Cypridacea Baird 1845
Family: Candonidae Kaufmann 1900
Subfamily: Candoninae Kaufmann 1900
Genus: Candonocypris Sars 1894
Candonocypris novaezelandiae (Baird) 1843

Remarks: This occurs in fewer numbers along

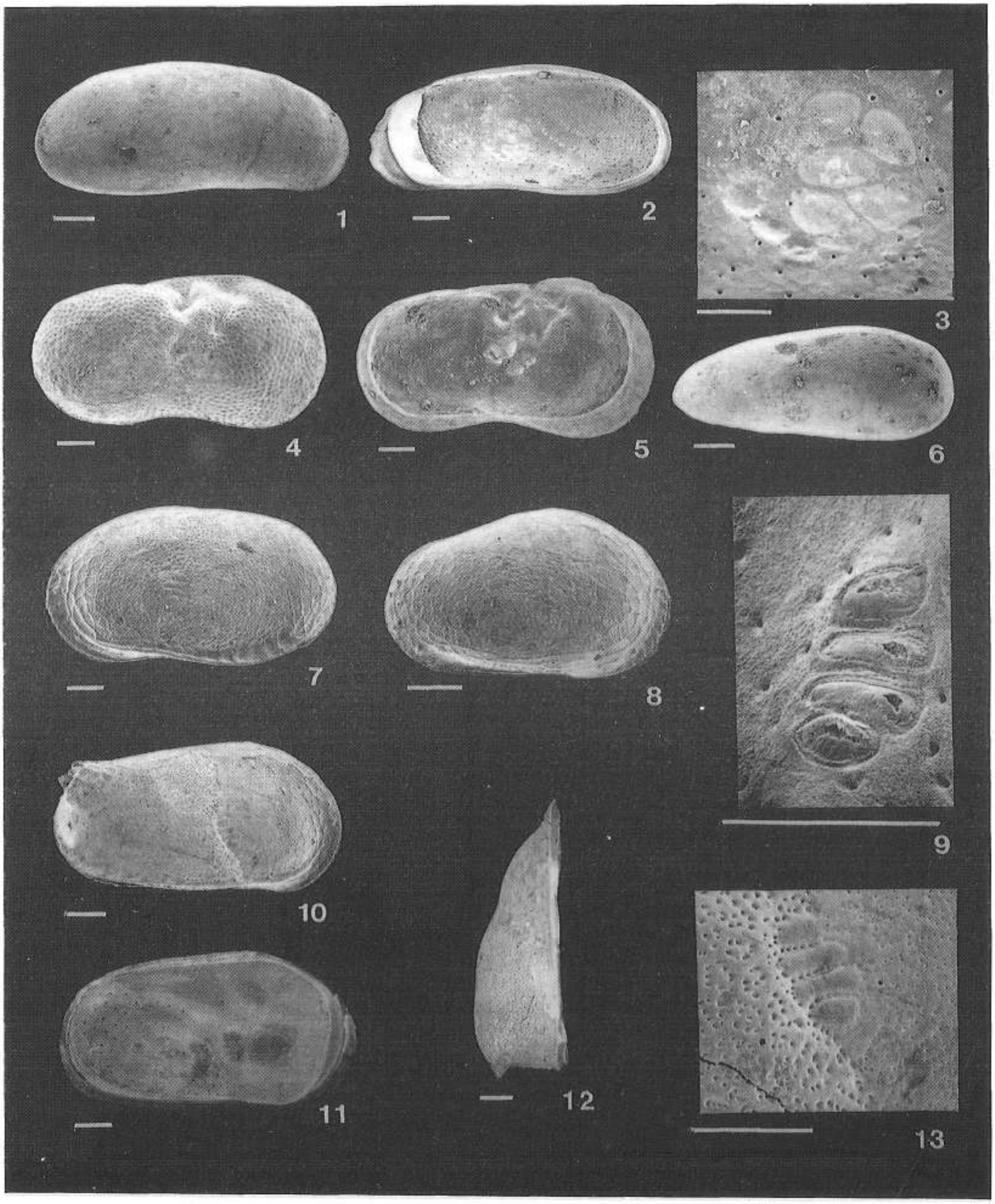

FIGURE 3. *Candonocypris novaezelandiae* (Baird): 1. exterior, right valve; 2. interior, right valve; 3 muscle scar, right valve. *Limnocythere mowbrayensis* Chapman: 4. exterior, right valve; 5. interior, left valve. *Darwinula sp.* 6. exterior, left valve. *Gomphocythere duffi* (Hornibrook): 7. exterior of left valve, male; 8. exterior of right valve, juvenile; 9. muscle scars; 10 exterior of right valve, female showing tubercle; 11 interior of left vale, female; 12 dorsal view of left valve, female; 13 detail of muscle scar area on (10). Scale bars are 0.1 mm for whole specimens and 0.01 mm for detailed photographs.

with *Gomphocyther duffi*. Today it lives in shallow water, muddy environments with abundant decaying organic material present. The absence of specimens recovered from the cream marls, where there is a lack of organic material, makes this consistant with its present living conditions.

DISCUSSION

The accumulation of the fossil lake sediments was cyclic, reflecting currents moving through the lake (with less organic matter preserved) and more static conditions (with more organic material and beds of peat present) the cyclicity, perhaps reflecting different water levels/currents in lake.

Nearby is a hydro-electric dam with a lake, the Kourarau dam lake. Like the Pleistocene lake deposit, the Kourarau dam lake, is also about 350 metres above sea level - an apparently similar environment. It has both slowly flowing water and static areas with decaying vegetation. The question that arises is whether diatoms were present in the fossil lake deposit or were destroyed by diagenesis? Examination of the present-day weed and sediments in the lake at Kourarau revealed that there are diatoms living there (M. A. Harper, pers comm). It is likely that they were present in the fossil lake and were removed by diagenesis.

Similarly, are the ostracods that are in the present lake the same or similar to the fossil deposit? *Darwinula*, a sandy bottom dwelling species is found in parts of the lake where there is little weed and where water is flowing slowly, particularly near the floodgate. Towards the intake for the lake among the weed, *Herpetocypris pascheri* and *Cypridopsis vidua* are living, neither of which are found in the fossil deposit.

The flora that have been recorded by Haskell (1962) and Vincent (1978) in the fossil deposit is comparable with that still present in the area. Similarly, the molluscs recorded are also present in the region. The large numbers of *Nothofagus* pollen recovered in the Pleistocene indicate a cooler climate, such as is found today in the higher slopes of the Tararuas to the west. This cooler climate was more widespread in the past at the time of the Pleistocene lake sediment deposition. Haskell (1962) concluded that the climatic conditions were similar to or slightly cooler than at the present time.

Accurate dating of the deposit is problematical as there are no age-diagnostic fossils present. Similarly, the paleomagnetic evidence is equivocal. The lake deposit unconformably lies on the Gladstone Formation (Kennett 1964) which in turn overlies the Pukenui Limestone (Kennett *et al.* 1971). The latter has produced an age of 1.6m.y. The underlying beds were dated by McGill (1956) with *Chlamys delicatula, Pelicaria rotunda, and P. accuminata,* as lower Nukumaruan. He inferred that the lake sediments were deposited in the relatively warm period following the retreat of *Chlamys delicatula* in the (middle) Nukumaruan. Thus the peats in the deposit would, therefore appear to be too old for a C14 determination.

It is concluded that the Pukenui Limestone which underlies the Hinewaka Formation was deposited in a basin which was, as now, open to the south. These marine limestone sediments were subsequently uplifted and eroded *before* the Hinewaka Formation was deposited.

The presence of *Chara* in the Hinewaka Formation indicates that the water was fresh with no saline components (see Burne *et al.* 1980). The lake was not formed close to the sea.

A similar fossil deposit is the Pyramid Valley swamp (Hornibrook 1955, Deevey 1955). The ostracod fauna there is richer and not as cyclical as at Kourarau. Moar (1970) gives an age of 4280 years BP for this deposit as determined from pollen diagrams.

Another present-day analogy to this deposit could be Lake Poukawa in Hawkes Bay (Harper *et al.* 1986). This lake is surrounded by hills rising to 300 m. Lake sediments are composed of a carbonate mud sitting on a basin of Te Aute Limestone peat deposits have accumulated around the margin. overall, the estimated sedimentation rate is 1.3 $mm.year^{-1}$ (Howorth & Froggatt 1981). However, unlike the Hinewaka Formation, a good diatom flora was collected from cores and tephra layers add to the silica content. There were 100 to 1000 times more diatoms in the lake sediment than in the peat. A high proportion of benthic (epipelic and epiphytic) diatoms throughout the length of all cores indicates a persistant shallow lake environment. Both acid and alkaline diatoms are found in the deposit associated with Lake Poukawa, whereas neither occur in the Hinewaka Formation. However, the author has not found any ostracods in the clays or peats associated with the Poukawa cores. This is not unusual as freshwater ostracods frequently are not preserved as fossils.

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